United States
Office of Personnel Management

FWS Job Grading Standard for

Electronics Mechanic

2604

Workforce Compensation & Performance Service
Office of Classification Programs
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WORK COVERED

This standard covers nonsupervisory work involved in the fabrication, overhaul, modification, installation, maintenance, troubleshooting and/or repair of ground, airborne, and marine electronic equipment, such as: radio; radar; sonar; cryptographic; industrial x-ray; marine, aeronautical and space navigation aid; TV receiver; surveillance; and similar devices. This work requires knowledge of the practical application of electronics principles; the ability to recognize improper operation, locate the cause, and determine the best method to correct the defect; and the skill to disassemble, assemble, and adjust electronic equipment.

WORK NOT COVERED

This standard does not cover work which primarily involves:

- Maintenance, repair, calibration, and certification of electronic test, measurement, and reference equipment used for precise measurement of electrical and electronic values. (See Electronic Measurement Equipment Mechanic Series, 2602.)

- Maintenance, repair, installation, and calibration of integrated electronic systems. (See Electronic Integrated Systems Mechanic Series, 2610.) (Note: The introduction to the 2600 family contains a detailed discussion of the difference between electronics mechanics and electronic integrated systems mechanics.)

- Installation, troubleshooting, repair, overhaul, and calibration of electronic control, indicating, and recording systems used on industrial machinery or engines. (See Electronic Industrial Controls Mechanic Series, 2606.)

- Installation maintenance, and repair of electronic digital computers and peripheral equipment. (See Electronic Digital Computer Mechanic Series, 2608.)

- Installing and maintaining electronic equipment when this is an integral part of the engineering testing, analysis, alignment, and performance evaluation of complex electronic systems, or when the employee is responsible for solving engineering problems of site selection, systems integration, and modification of the equipment to adapt to novel site characteristics. (See Electronics Technician Series, GS-856.) (Note: The introduction to the 2600 family contains a detailed discussion of the differences between electronics mechanic and electronics technician work.)

- Installation, modification, troubleshooting, repair, and overhaul of wire communications equipment which predominately requires knowledge of electro-mechanical equipment theory and operation. (See Wire Communications Equipment Installation and Maintenance Family, 2500.)

- Installation, modification and repair of electrical systems in aircraft, watercraft, buildings, and mobile or transportable vans and vehicles which provide power to or carry signals between electronics equipment, where the primary knowledge and skill is of electrical circuitry and electrical principles and formula. (See the Electrical Installation and Maintenance Family, 2800.)

- Installation, overhaul, troubleshooting, and repair of auto pilot, flight control, navigation, and fire control equipment which predominantly requires knowledge of mechanical, electrical, pneumatic, and hydraulic principles and mechanisms. (See Instrument Mechanic Series, 3359.)

TITLES

Jobs covered by this standard which arc graded below grade 10 (other than Helper and Intermediate jobs) are to be titled Electronics Worker. Jobs covered by this standard at grade 10 or above are to be titled Electronics Mechanic.

GRADE LEVELS

This standard does not cover all possible grade levels for this occupation. If jobs differ substantially from the level of skill, knowledge, and other work requirements described for grade levels in the standard, they may be graded above or below these grades, based on the application of sound job grading principles.

HELPER AND INTERMEDIATE JOBS

Helper and intermediate electronics jobs are graded by the Office of personnel Management job grading standards for Trades Helper and Intermediate jobs. (Grade 11 in this standard is to be used as the journeyman grade" in applying the Intermediate Job grading Table.)

NOTES TO USERS

For discussion of such factors as impact of solid state technology on the occupation, equipment complexity versus complexity of work assignees, guides for deciding if work is general schedule or wage grade, and a detailed discussion of the difference between electronics mechanic and electronic integrated systems mechanic, refer to the Introduction to the Electronic Equipment Installation and Maintenance Family, 2600.

Definitions: Certain general terms may have different leanings to different users of this standard. For the purpose of this standard, the following terms are defined as:

Part. The lowest subunit of electronics devices, the basic detachable segments or pieces from which contiguous subassemblies are constructed. That unit which usually must be soldered, connected, wired, attached to a pressboard or similar receptacle. Representative examples include: transistor, thermister, diode, resistor, capacitor, vacuum tube, rectifier, switch, IC chip, blank pressboards etc.

Assembly. A structural unit of interconnected parts comprising a circuit to perform a singular phase of an electronics function. Representive examples include: power supply regulator circuit, audio or video amplifier circuit, intermediate amplifier strip, transmitter modulator, etc.

Assembly. A grouping of circuits and/or subassemblies normally interconnected to a chassis or modular pressboard forming a complete unit capable of performing an electronics function. An assembly cannot normally be removed as an intact end-item from the chassis or pressboard. Representative examples include: regulated power supply module, audio board of a modular TV set, intermediate frequency board, transmitter final output module, broadcast phase of a walkie talkie radio, etc.

Component. A grouping of assemblies and/or circuit modules which performs a full electronics function and is normally regarded as an end-item or detachable operational module. Each unit is normally capable of performing a complete linear or operational electronics function as a secondary or supporting constituent element of a complex electronics system. Representative examples include: multiplexer, amplifier of a public address system, receiver set or transmitter set of a complex transceiver, audio or video portion of a color television set, cathode ray tube (PPI) display console and controls of a radar, etc.

System. A grouping of advanced electronics assemblies, and major components which frequently performs two or more substantially unrelated electronics functions where each is dependent on the interaction of one segment to another in the performance of an orderly working totality. Components often and usually involve the presence of numerous and complex integrated circuitry and overall systems operability is impacted by the interface of components and their collective reliability. Malfunction diagnostics and repair require a full-systems approach as functional problems in one portion of the system can often emanate from a seemingly unrelated source within the overall system. Representative examples include: cryptographic encoding and decoding devices, closed circuit color TV studio, TACAN air navigation transponder beacon, microwave link terminals and repeaters, sonar, precision ground control approach radar, ATC search radar, etc.

Prototype. An original model on which something is patterned.

2604-8 ELECTRONICS WORKER, GRADE 8 2604-8

General: Grade 8 Electronics Workers apply standardized, specific procedures and techniques to perform fabrication, installation, modification, overhaul, maintenance and repair of electronic equipment of limited complexity such as subassemblies, printed circuit cards, and chassis. Typical work assignments at this level are:

- Operates automatic test equipment which has been programmed to a type of chassis or printed circuit board in order to locate the defective part. Replaces the part and runs through the test again to assure proper repair.

- Receives defective circuit cards or chassis, such as audio frequency (AF) or radio frequency (RF) amplifiers, power supplies, oscillators or other assemblies which are of limited design and functional complexity. Makes visual check and repairs obvious damage. Applies test signal and checks out circuit. Locates and repairs malfunctions.

- Works as a team member in the installation, repair, and maintenance of complete systems by performing more simple and routine tasks such as identifying, checking, and connecting power and signal cables, replacing defective parts and assemblies which have been identified by higher grade mechanics, or monitoring system operation by following operating and testing procedures for the system and associated test equipment, and identifying and reporting improper operating indications.

- Constructs individual chassis and components of electronic equipment in accordance with detailed schematics, layout diagrams, and assembly instructions. Tests work by checking circuit continuity, resistance and impedance, and similar values as specified in assembly instructions.

Grade 8 Electronics Workers determine the work sequence on routine, repetitive assignments.

Skill and Knowledge: Grade 8 Electronics Workers require:

- Knowledge of construction practices of electronic equipment in order to recognize types and sizes of resistors, capacitors, wiring, transistors, etc.; follow signal paths through printed circuit and wired circuitry, recognizing actual circuit configurations which are shown in schematics and diagrams. Skill in removing and replacing specified parts, following standard methods.

- Knowledge of standardized shop practices and procedures such as soldering procedures for construction or repair of printed circuit boards and mechanical and electrical placement and hookup of parts and subassemblies in larger chassis and consoles. Familiarity with basic test equipment operation such as voltmeters, ohmmeters, AF and

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RF signal generators, and oscilloscopes or preprogrammed automatic test units in order to follow specified checkout procedures and compare readings with specified values.

- Knowledge of electrical and electronic theory such as the electromagnetic basis of alternating current and inductive and capacitive reactance, series and parallel tuned circuits, impedance matching, and operation of vacuum tubes and transisters. Skill in applying such knowledge to follow the testing procedures for chassis or circuit boards with one or a few types of circuit such as an intermediate amplifier strip, an audio detector, power supply, etc.

- Skill in reading schematics of uncomplicated assemblies such as power supplies, audio amplifiers, and switching panels to determine value, polarity, and location in the circuit of defective parts, determine proper test points for measuring values of parts, voltages, etc. Skill in applying precise instructions and specifications describing fabrication, test or repair procedures to be followed.

- Skill in the use of the usual hand tools of the electronics trade, such as drills, chassis punches, wrenches, soldering irons and microsoldering units to remove and replace circuit parts where accurate positioning, appearance, mechanical strength and electrical integrity are important.

- Knowledge of common testing procedures such as use of vacuum tube voltmeters to prevent loading of high impedance circuits when testing for operating voltages and use of signal generators and oscilloscopes to visually trace the progression of a signal through a discriminator and amplifier section.

Responsibility: Grade 8 Electronics Workers receive detailed oral instructions and written work orders from the supervisor or a higher grade employee. On routine assignments, they independently determine work methods and the use of tools and test equipment. Judgments and decisions at this level are guided by clearly described procedures and instructions, and the work consists of recurring steps involved in the disassembly, repair, replacement, and test of parts and subassemblies and assemblies. The work is spot-checked during the progress of the task or work order and the supervisor or higher grade worker is usually available for any necessary assistance. Completed work is checked for compliance with instructions, specifications, and standardized shop practices and procedures. New assignments are performed under close review.

Physical Effort: Work assignments require light to moderate physical effort. Employees frequently lift, carry, or otherwise handle items weighing up to 18 kilograms (40 pounds). Occasionally they handle items greater than 18 kilograms. Assistance is usually available with heavy items. They work in a sitting position for extended periods. Frequent standing,

walking, bending, crouching, reaching and stooping is required. Occasionally, climbing and work in high places is required.

Working Conditions: Work is usually performed inside in well lighted, heated, and ventilated areas. Work is sometimes in aircraft or ships, in high or restricted places, under conditions of heat or cold, and occasionally outside in inclement weather. Employees are subject to injuries such as electric shock, cuts and bruises, as well as burns caused by electrical or RF energy, or soldering irons.

2604-10 ELECTRONIC MECHANIC, GRADE 10 2604-10

General: As compared to the subassemblies, printed circuit cards, and chassis of limited complexity assigned to Grade 8 Electronics Workers, Electronics Mechanics, Grade 10 perform the overhaul, installation, maintenance, modification and repair of various types of electronic equipment which is characterized by moderate complexity of design, construction, and function. Items serviced at this level are usually self-contained and functionally independent. Representative of this degree of complexity are color TV receivers, high fidelity sound equipment, closed circuit TV monitor systems, public address and nurse call systems, handi-talkie type 2-way radios, doppler police radar, and multichannel very high frequency (VHF) or ultra high frequency (UHF) transmitters or receivers. Typical work assignments at this level are:

- Work as "television repairer", troubleshooting and repairing a wide variety of TV receivers, stereo record players and tape recorders, and public address systems. Assignments are on an "as received" basis without direct technical supervision.

- Install components of electronic systems such as UHF ground to air or HF tactical radios and associated control consoles, teletype units, multiplexers, etc. in shelters, vehicles, aircraft, or buildings. Hook up units to cabling, make operational tests, repair malfunction of cabling and units in accordance with standard trade practices.

- "General repair shop" assignments working on a wide variety of equipment such as regulated power supplies, transmitters, receivers, high power linear amplifiers, loran receivers, and radio teletype units.

- Operation of computerized automatic test equipment (ATE) to test and troubleshoot various components of major electronics systems, such as aircraft flight control, fire control, or missile guidance. Loads computer with test program for the unit under test, selects appropriate interface device, connects required stimulation and measurement blocks, hooks up unit under test and activates ATE. Evaluates fault reports to determine if item should be returned to repair section or if repair or adjustment can be made so testing can continue.

Skill and Knowledge: Grade 10 Electronics Mechanics require:

- Knowledge of standard construction, layout, and circuit principles such as typical circuits, parts values, and operation of commercial TV receivers and hi-fi amplifiers or of a variety of radar display consoles, etc. Skill in the repair of malfunctions, using knowledge of previous similar circuits and problems as precedents in determining the approach to the problem and the optimum solution with minimum of trial and error.

- Knowledge of customary trade practices in the repair of functionally independent electronic equipment in order to select tools and equipment needed and layout the approach to the problem. Skill in adapting the generally successful procedures and practices to occasional changes of materials or equipment or performance specifications.

- Knowledge of general electronic theory including the properties of various tube type and solid state sine wave oscillator circuits, mixer circuits, AF, RF and broad band video amplifiers circuits, circuit stabilization, high and low power transmitter modulation, or similar knowledge pertaining to the types of equipment repaired. Skill in applying this knowledge to understand the operation of the equipment to be repaired and the effects on circuit operation of changes in voltage, current, frequency, or parts outages.

- Knowledge of electronics drawings and schematics of moderate complexity, for individual electronics units where all assemblies and connections can be presented together and interconnections between circuits are clearly presented. Skill in recognizing and determining the operation of the circuits, locating the points in the circuits from which to take readings, and analyzing the schematic layout to determine which components could cause observed malfunction indications.

- Knowledge of standard troubleshooting procedures. Skill in diagnosing problems and determining corrective action where the number of possible trouble points is restricted due to simplicity of circuit design and the limited number of circuits which are necessary to achieve the design objective. For example, troubleshooting a communications receiver outage where readings from built-in test points show good radio frequency and local oscillator input to the mixer stage but intermittent output from a test point following the second intermediate frequency amplifier stage, requiring close analysis of only 3 circuits, the mixer and the 1st and 2nd IF amplifiers.

Responsibility: Compared to the limited repair tasks performed and the specific instructions received at the grade 8 level, the grade 10 Electronics Mechanic independently determines the nature of trouble and extent of repair required on relatively uncomplex electronic equipment. Grade 10 mechanics receive work assignments from a supervisor or higher grade mechanic in the form of oral instructions or written work orders. They determine work sequence, select test instruments, locate the malfunction, and complete the repairs. They make operational tests of all components, equipment, or systems repaired to assure proper operation. Repairs do not usually require adjustment and alignment of other related equipment in a larger system. Technical data covering equipment, methods, and procedures are complete and specific except for items of limited complexity such as TV receivers and PA systems where most of the equipment is quite similar and knowledge of one make or model of equipment is easily adapted to other makes and models. Work is spot-checked for compliance with directives, specifications, and accepted trade practices.

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Physical Effort: The physical effort required at this level is the same as that described at the grade 8 level.

Working Conditions: The working conditions at this level are the same as those described at the grade 8 level.

2604-11 ELECTRONICS MECHANIC, GRADE 11 2604-11

General: As compared to the self-contained, functionally independent equipment of moderate complexity typical of work at the grade 10 level, Electronics Mechanics, grade 11 perform overhaul, installation, maintenance, modification, and repair of electronics equipment and complete operational systems which require knowledge of a wide range of electronics principles and practices. Examples of equipment and systems at this degree of complexity are: closed circuit color TV studio, TACAN air navigation transponder beacon, microwave link terminals and repeaters, sonar, precision ground control approach radar, and air traffic control search radar. Typical work assignments at this level are:

- Maintain, test, and repair complete navigational aids such as TACAN units, air traffic control long range search radar, with features such as moving target indicator and information digitizer, and instrument landing system localizers, glide slope transmitters, radio marker beacons and monitor and control devices.

- Install, maintain and repair discrete avionics systems in aircraft. Evaluate pilot trouble reports, test, and repair a variety of equipment such as weather radar, target identification (IFF) transponders, autopilots, TACAN, radar altimeters and other standard light weight avionics equipment.

- Maintain, repair, install, and make operational checks on a variety of complex equipment and complete systems ranging from low and medium power search radar to sonar scanning equipment, cryptographic encoders and decoders, and electronic counter measures equipment.

- Install, maintain and repair complete digital electronic switching centers and associated electronic cryptographic equipment and digital subscriber terminal equipment. Inspect and test for TEMPEST maintenance and correct deficiencies which do not require engineering design changes.

Skill and Knowledge: Grade 11 Electronics Mechanics require:

- Knowledge of operation, capabilities and limitations of complex electronics systems. For example, skill in overhaul, alignment and test of a color TV studio. Skill in relating the operating parameters of the various cameras, control consoles, monitors, etc. in order to determine and evaluate the significance of voltage, current wave shape, phase shift, - etc. at various points throughout the circuits and relate these to overall operation of the system.

- Broad knowledge of electronic shop and trade practices. For example, knowledge of test equipment capability, standard practices for test and operation, theory of operation of the numerous types of electronic circuits, and their effect on one another. Skill in applying

this knowledge to adapt test procedures to available test equipment, to develop short cuts to return equipment to operation in a limited time, and to switch from one point of theory to another depending on what types of circuit are being worked on.

- Broad practical knowledge of electronics principles and their application to a wide variety of complex circuitry such as pulse forming networks, time delay lines, klystron operation, electromagnetic propagation, microwave techniques, etc. Skill in applying this knowledge to troubleshoot and repair malfunctions where circuit theory must be used to understand the operation not only of individual circuits but the possible interaction of other circuits to create a malfunction for example, when circuits check out in one mode of operation but the same circuits do not function when used in another mode.

- Skill in the interpretation of drawings, specifications and schematics of complete systems, such as a color TV studio, to recognize the function and interconnections of the various assemblies and troubleshoot the system from the schematic, following signal paths through a complex path of interconnections of components, assemblies, subassemblies and connecting cable harnesses.

- Ability to diagnose problems and determine corrective action for complex electronic units and complete systems such as cryptographic encoder/decoders, precision radar systems, and electronic switching centers. Ability to see through the interaction of a number of complex, interrelated circuits such as timing circuits, pulse forming networks, feedback stabilized high power amplifiers, etc. to determine not only the obvious cause of a malfunction such as a blown transistor but the interaction of factors, e.g., high ambient temperature and the power and duration of the signal input, which together caused it to fail.

Responsibility: Grade 11 Electronics Mechanics receive work assignments from the supervisor in the form of written work orders and inspection reports and oral instructions. They work in accordance with available drawings, technical orders, or specifications. In comparison to the work performed by mechanics at the grade 10 level, work assignments at this level require more judgments and decisions regarding the methods and procedures for completing assignments which may involve extending the use of conventional tools and equipment, and improvising changes to techniques and procedures to reach specified parameters when aging of components or modification of circuits have changed operating conditions. The mechanics are responsible for knowing and judging the impact of repairs, that is, the effects that changes and adjustments will have on the related integral devices of the equipment serviced. They are also responsible for making further tests and alignments to insure that the completed equipment is aligned and functioning properly.

The mechanics plan the work sequence and determine that equipment meets the requirements for serviceability, especially when working in remote user locations. They are also responsible for applying sound judgment in decisions which contribute toward greater operating life and efficient operations. The mechanics at this level must keep abreast of technological changes in the occupation, and provide technical guidance and assistance to lower grade employees.

Technical advice is available on unusually difficult problems. Completed work is spot-checked for compliance with accepted trade practices and specifications.

Physical Effort: Physical effort is the same as that described at the grade 8 level.

Working Conditions: Working conditions at this grade are the same as those described at the grade 8 level.

2604-12 ELECTRONICS MECHANIC, GRADE 12 2604-12

General: As compared to the complete standard operational systems typical of work at the grade 11 level, Electronics Mechanics, grade 12 work on new systems of great complexity. They serve on "lead off" teams to implement maintenance and repair procedures on major electronics systems which are new to the activity or which are major modifications of systems previously assigned so that the activity lacks knowledge of the system problem areas and expertise in its repair. They maintain prototype systems during the first operational deployment and improvise procedures to cope with unforeseen defects. They "breadboard" experimental equipment from sketches and verbal instructions to provide test data for test and refinement of new designs. Assignments are characterized by application of advance electronic theory and frequent technological changes in systems.

Skill and Knowledge: Grade 12 Electronics Mechanics require:

- Extensive practical knowledge of operation, capabilities and limitations of electronic equipment and systems. Skill in applying this knowledge to understand prototype and experimental systems in order to improvise alignment, repair, and operating procedures which will be efficient, complete, and compatible with available resources.

- Ingenuity in the application of shop and trade practices to solve operating and repair problems, for example, to improvise alignment procedures for a redesigned radar system in which a number of the major subsystems have been modified with the introduction of integrated circuits.

- Practical knowledge of electronic theory and design. Ability to use theoretical concepts to devise solutions for operating or repair problems on experimental systems in which novel engineering approaches have created unforeseen problems.

- Skill in interpreting electronics drawings, specifications, and schematics of complete prototype systems such as a new data transmission system with analog-to-digital converters, pulse generators, multiplexers, timing circuits, microwave transmitters and receivers, and similar involved subunits which create and use many interlocking signals.

- Skill in troubleshooting complex electronic systems characterized by unusual circuit arrangements and theories and lack of developed documentation.

Responsibility: In comparison to the grade 11 Electronics Mechanics who receive general assignments for work on well proven and well documented equipment, grade 12 Electronics Mechanics exercise significantly more judgment and independence in determining the methods and techniques required to solve unusually complex maintenance and repair problems. For example, they independently judge the need for modification of test devices, or the work sequences, and for special or nonstandard trade techniques. They improvise and

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submit for approval changes to detailed schematics, drawings and maintenance procedures for use by lower grade employees. Grade 12 mechanics must keep abreast of technological changes in the occupation to understand new electronics theories and applications and provide technical guidance and assistance to lower grade employees. They coordinate their efforts with technical and professional personnel on matters affecting operating specifications and changes to equipment. The supervisor assigns work orally and through written instructions which outline the purpose of the work and possible approaches. Work is reviewed by occasional spot-checks and review of documentation developed.

Physical Effort: The physical effort required at this level is the same as that described at the grade 8 level.

Working Conditions: The working conditions at this level are the same as those described at the grade 8 level.